

Claims

- [c1] An interconnect structure formed on a substrate, the structure comprising:
- a first layer of a first dielectric material having at least one first conductor embedded therein, the first conductor having a top surface coplanar with a top surface of the layer of dielectric material; and
 - a second layer of a second dielectric material overlying the first layer of dielectric material and having at least one second conductor embedded therein, the second conductor comprising at least one first portion and at least one second portion, the second portion being formed of a material different from the first portion, wherein the first portion is in electrical contact with the first conductor, the second portion is overlying and in electrical contact with the first portion, the second portion has a lateral extent greater than that of the first portion, and the second portion has a top surface coplanar with a top surface of the second layer of dielectric material.
- [c2] The interconnect structure of Claim 1, further comprising:
- a first conductive liner disposed between the first portion and the second dielectric material and between the first portion and the first conductor; and
 - a second conductive liner disposed between the second portion and the second dielectric material and between the second portion and the first portion, the second liner being formed of a material different from the first liner.

- [c3] The interconnect structure of Claim 1, further comprising a hardmask layer overlying the second layer of dielectric material, and wherein the second portion of the second conductor has a top surface coplanar with a top surface of the hardmask layer.
- [c4] The interconnect structure of Claim 1, wherein the second dielectric material is the same as the first dielectric material.
- [c5] The interconnect structure of Claim 1, wherein the second dielectric material is different from the first dielectric material.
- [c6] The interconnect structure of Claim 1, wherein the second portion is formed of copper and the first portion is formed of tungsten.
- [c7] The interconnect structure of Claim 2, wherein the first liner is formed of a material selected from the group consisting of titanium nitride, tantalum, tantalum nitride and tungsten, and the second liner is formed of a material selected from the group consisting of tantalum nitride and tantalum.
- [c8] The interconnect structure of Claim 2, wherein the second liner has a thickness less than the thickness of the first liner.
- [c9] An interconnect structure formed on a substrate, the structure comprising:
a first layer of a first dielectric material having at least one first conductor embedded therein, the first conductor having a top surface coplanar with a top surface of the layer of dielectric material;

a second layer of a second dielectric material overlying the first layer of dielectric material and having at least one second conductor embedded therein, the second conductor comprising at least one first portion and at least one second portion, wherein the first portion is in electrical contact with the first conductor, the second portion is overlying and in electrical contact with the first portion, the second portion has a lateral extent greater than that of the first portion, and the second portion has a top surface coplanar with a top surface of the second layer of dielectric material;

a first conductive liner disposed between the first portion and the second dielectric material and between the first portion and the first conductor; and

a second liner disposed between the second portion and the second dielectric material, the second liner having a thickness less than the thickness of the first liner.

- [c10] The interconnect structure of Claim 9, further comprising a hardmask layer overlying the second layer of dielectric material, and wherein the second portion of the second conductor has a top surface coplanar with a top surface of the hardmask layer.
- [c11] The interconnect structure of Claim 9, wherein the second dielectric material is the same as the first dielectric material.
- [c12] The interconnect structure of Claim 9, wherein the second dielectric material is different from the first dielectric material.

- [c13] The interconnect structure of Claim 9, wherein the second conductor is formed of copper.
- [c14] The interconnect structure of Claim 9, wherein the first liner comprises a material selected from the group consisting of titanium nitride, tantalum, tantalum nitride and tungsten, and the second liner comprises a material selected from the group consisting of tantalum nitride and tantalum.
- [c15] The interconnect structure of Claim 1, further comprising:
a conductive liner disposed between said second conductor and the second dielectric material and between the second conductor and the first conductor.
- [c16] The interconnect structure of Claim 15, further comprising a hardmask layer overlying the second layer of dielectric material, and wherein the second portion of the second conductor has a top surface coplanar with a top surface of the hardmask layer.
- [c17] The interconnect structure of Claim 15, wherein the second dielectric material is the same as the first dielectric material.
- [c18] The interconnect structure of Claim 15, wherein the second dielectric material is different from the first dielectric material.
- [c19] The interconnect structure of Claim 15, wherein the liner comprises a material selected from the group consisting of titanium nitride, tantalum, tantalum nitride and tungsten.

[c20] A method for forming an interconnect structure on a substrate, the substrate comprising a first layer of a first dielectric material having at least one first conductor embedded therein, the first conductor having a top surface coplanar with a top surface of the layer of dielectric material, the method comprising the steps of:

depositing a second layer of a second dielectric material on the first layer of dielectric material;

forming at least one first opening in the second layer of dielectric material, the first opening partially exposing the first conductor;

filling the first opening with a first conductive material;

removing a top portion of the first conductive material;

forming at least one second opening in the second layer of dielectric material, the second opening overlying the first conductive material, and the second opening having a lateral extent greater than that of the first opening; and

filling the second opening with a second conductive material, wherein the second conductive material is different from the first conductive material, and the second conductive material has a top surface which is made coplanar with the top surface of the second layer of dielectric material.

[c21] The method of Claim 20, further comprising the steps of:

depositing a first conductive liner on the bottom and sidewalls of the first opening, prior to filling the first opening with the first conductive material; and

depositing a second conductive liner on the bottom and sidewalls of the second opening, prior to filling the second opening with the second conductive material.

[c22] A method for forming an interconnect structure on a substrate, the substrate comprising a first layer of a first dielectric material having at least one first conductor embedded therein, the first conductor having a top surface coplanar with a top surface of the layer of dielectric material, the method comprising the steps of:

- depositing a second layer of a second dielectric material on the first layer of dielectric material;
- forming at least one first opening in the second layer of dielectric material, the first opening partially exposing the first conductor;
- depositing a first conductive liner on the bottom and sidewalls of the first opening;
- filling the first opening with a sacrificial material;
- forming at least one second opening in the second layer of dielectric material, the second opening overlying the first opening, and the second opening having a lateral extent greater than that of the first opening;
- removing the sacrificial material;
- depositing a second conductive liner on the bottom and sidewalls of the second opening and on the first liner; and
- filling the second opening with a conductive material, thereby forming a second conductor, wherein the second conductor has a top surface

which is made coplanar with the top surface of the second layer of dielectric material.

- [c23] A method for forming an interconnect structure on a substrate, the substrate comprising a first layer of a first dielectric material having at least one first conductor embedded therein, the first conductor having a top surface coplanar with a top surface of the layer of dielectric material, the method comprising the steps of:
- depositing a second layer of a second dielectric material on the first layer of dielectric material;
 - forming at least one first opening in the second layer of dielectric material, the first opening extending partially through the second layer of dielectric material but not exposing the first conductor;
 - forming at least one second opening in the second layer of dielectric material and extending the first opening through the remainder of the dielectric material, thereby exposing the first conductor, the second opening overlying the first opening and the second opening having a lateral extent greater than that of the first opening;
 - depositing a first conductive liner on the bottom and sidewalls of the first and second openings;
 - filling the first and second openings with a first conductive material;
 - removing the first conductive material and the first liner from the second opening;
 - depositing a second conductive liner on the bottom and sidewalls of the second opening;

filling the second opening with a second conductive material, wherein the second conductive material is different from the first conductive material, and the second conductive material has a top surface which is made coplanar with the top surface of the second layer of dielectric material.

[c24] A method for forming an interconnect structure on a substrate, the substrate comprising a first layer of a first dielectric material having at least one first conductor embedded therein, the first conductor having a top surface coplanar with a top surface of the layer of dielectric material, the method comprising the steps of:

depositing a second layer of a second dielectric material on the first layer of dielectric material;

forming at least one first opening in the second layer of dielectric material, the first opening extending partially through the second layer of dielectric material but not exposing the first conductor;

forming at least one second opening in the second layer of dielectric material and extending the first opening through the remainder of the dielectric material, thereby exposing the first conductor, the second opening overlying the first opening and the second opening having a lateral extent greater than that of the first opening;

depositing a conductive liner on the bottom and sidewalls of the first and second openings;

filling the first and second openings with a first conductive material;

removing the first conductive material from the second opening; and

filling the second opening with a second conductive material, wherein the second conductive material is different from the first conductive material, and the second conductive material has a top surface which is made coplanar with the top surface of the second layer of dielectric material.